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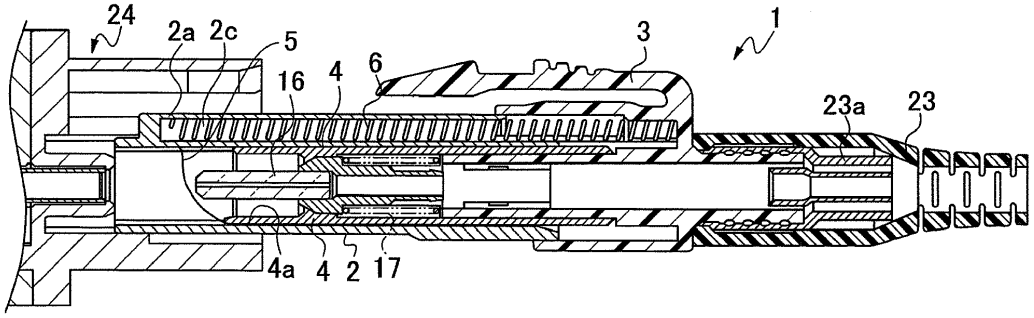
(54) **Optical connector plug with shutter**

(57) An optical connector plug with a shutter to be fitted to an optical connector adapter (24) includes: a plug frame (4) configured to hold a ferrule (16); a square cylindrical front housing including a shutter (5) that opens and closes with a movement of the ferrule (16); a locking housing (3) fixedly and integrally connected to the plug frame (4) and configured to be fitted into and be locked with the optical connector adapter (24); and a spring (6) that biases the front housing (2) forward. The plug frame (4) is moved forward by a rearward movement of the front housing (2), a front opening edge portion of the plug frame expands the shutter (5) into a straight shape, and the shutter (5) includes slits (5c) straddling over a boundary between a flat portion (5a) and a curved portion (5b) when light is blocked, and a protrusion formed by a center portion being deformed by the expanded shutter (5) when being fitted is cancelled.

Fig. 1A



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Description

[0001] The present invention relates to an optical connector plug with a shutter represented by an LC-type plug used for a connecting end of an optical fiber cable.

[0002] In the prior art, an optical connector plug with a shutter illustrated in Fig. 7A to Fig. 11C, for example, an LC type plug 15 with a shutter described as a representative example includes: a cylindrical plug frame 18 having a ferrule 16 and a resilient member 17 configured to bias the ferrule 16 forward in the interior thereof; a cylindrical front housing 19 surrounding the plug frame 18 so as to be in free sliding contact with an outside thereof; one light-shielding plate (shutter) 22 having a curved shape, fixed at one end portion thereof to an inner wall of the front housing 19, and configured to block light at a position in front of the ferrule 16; and a locking housing 20 configured to be fitted from the rear of the plug frame 18 as described in JP-A-2011-13606.

[0003] With the LC-type plug with a shutter 15, the light shielding plate 22 blocks a laser from the ferrule 16 to protect eyes or the like in a non-connected state, the light-shielding plate 22 comes into abutment with an opening edge portion of the plug frame 18 by a rearward movement of the front housing 19 in a connected state and is extended from a curved shape to a straight shape, and the ferrule 16 projects from an opening end of the front housing 19 moved rearward. Accordingly, the ferrule 16 on the LC type plug 15 with a shutter side and a ferrule on an LC type adapter 24 side, which is a connection counterpart (see Figs. 6A and 6B) are connected.

[0004] However, since the light-shielding plate 22 in the LC type plug 15, which is an example of the optical connector plug with a shutter of the prior art, is brought into a state of being sandwiched between the plug frame 18 and the front housing 19 when being fitted to the LC type adapter 24 and hence is stored in a state of being subjected to a load, a center portion of the light-shielding plate 22 is deformed and protruded.

[0005] Accordingly, a retaining square hole 22c provided on the light-shielding plate 22 illustrated in Figs. 10A and 10B may climb over a central projection 19c for locking the light-shielding plate on a bottom portion of the front housing 19 illustrated in Figs. 11B and 11C, so that the light shielding plate 22 may come off from the front housing 19 during an opening and closing action repeated by the front housing 19.

[0006] An optical connector plug with a shutter of the invention is proposed for solving the above-described problems.

[0007] In order to solve the above-described problem, an optical connector plug with a shutter of the invention is an LC type plug to be fitted to an optical connector adapter, including: a plug frame configured to hold a ferrule; a square cylindrical front housing arranged so as to be slidable on the plug frame and including a shutter configured to open and close in association with a movement of the ferrule at a distal end side opening; a locking housing fixedly and integrally connected to the plug frame configured to be fitted into and be locked with the optical connector adapter; and a spring configured to bias the front housing forward, wherein the plug frame relatively moves forward by a rearward movement of the front housing so that a front opening edge portion of the plug frame expands the shutter which is curved on an optical axis of the distal end side opening of the front housing and blocking light into a straight shape, and the shutter includes a slit so as to straddle over a boundary portion between a flat portion and a curved portion in a state in which light is blocked, and a protrusion formed by a center portion being deformed in a state in which the shutter is expanded when being fitted into the optical connector adapter is cancelled.

[0008] A retaining mechanism which retains the shutter from coming off the front housing includes a retaining hole formed at a center of a flat portion of the shutter, locking protrusions formed at both rear ends of the flat portion, a locking projection to be fitted to the retaining hole formed in the front housing, and locking portions configured to lock the locking protrusions.

[0009] According to the optical connector plug with a shutter of the invention, the slit is formed on the shutter in a state in which the shutter is expanded when the adapter is connected, so that the center portion is not deformed and is prevented from protruding even when being sandwiched between the front housing and the plug frame. Accordingly, the probability that the square hole for retaining the shutter climbs over the retaining projection of the front housing, and the shutter comes off is eliminated.

[0010] In addition, since the number of positions where the locking portions are provided in the retaining mechanism is increased from one in the prior art to three, and the shutter is reliably fixed to the front housing, a superior advantage that the retaining function is improved is achieved.

Figs. 1A and 1B are a partly vertical cross-sectional view illustrating a state in the course of connecting an optical connector plug with a shutter of the invention to an LC type adapter 24, which is an optical connector adapter, and a vertical cross-sectional view illustrating a state in which the connection is completed part thereof in an enlarged scale;

Figs. 2A and 2B are a semi-cross-sectional perspective view illustrating a state in which the optical connector plug with a shutter is not connected, and a semi-cross-sectional view illustrating a connected state;

Figs. 3A and 3B are a perspective view illustrating a front housing in the optical connector plug with a shutter, and a perspective view illustrating a shutter;

Figs. 4A and 4B are a perspective view and a bottom view of the front housing viewed from a back side, respectively;

Fig. 5 is a perspective view illustrating another ex-

ample of shutter;

Figs. 6A and 6B are a perspective view illustrating a state of connecting the optical connector plug to the LC type adapter, and a perspective view illustrating a state after the connection;

Figs. 7A and 7B are a perspective view illustrating an LC type plug with a shutter, which is an optical connector adapter with a shutter of the prior art, and a perspective view illustrating a state in which the front housing is removed from the LC type plug with a shutter;

Figs. 8A and 8B are a perspective view illustrating a front housing in the LC type plug with a shutter, and a perspective view illustrating a shutter;

Fig. 9A is a perspective view illustrating a plug frame of the LC type plug with a shutter;

Fig. 9B is a cross-sectional plan view illustrating the plug frame of the LC type plug with a shutter;

Fig. 9C is a side view of the plug frame illustrating the LC type plug with a shutter;

Fig. 9D is a front view of the plug frame illustrating the LC type plug with a shutter;

Fig. 9E is a rear view of the plug frame illustrating the LC type plug with a shutter;

Figs. 10A and 10B are a perspective view and a plan view illustrating the shutter of the LC type plug with a shutter, respectively; and

Figs. 11A, 11B, and 11C are a perspective view, a cross-sectional plan view, and a semi-cross-sectional perspective view illustrating a front housing in the LC type plug with a shutter.

[0011] An optical connector plug 1 with a shutter according to the invention is characterized in that a shutter 5 as a light-shielding plate includes slits 5c added thereto so as to straddle a flat portion 5a and a curved portion 5b so that a center portion of the shutter is not deformed when being expanded into a straight shape at the time of being fitted and connected as illustrated in Figs. 3A and 3B.

Example 1

[0012] The optical connector plug 1 with a shutter of the invention is fitted into an LC type adapter 24 as an optical connector adapter as illustrated in Figs. 6A and 6B. The optical connector plug 1 roughly includes, as illustrated in Figs. 1A to 2B, a slidable front housing 2 being a cylindrical body having a square cylindrical shape, provided with the shutter 5 at a front opening, and being biased constantly forward by a spring 6, a cylindrical locking housing 3 configured to store a rear portion of the front housing 2 being retracted, and engage the LC type adapter 24 as a connection counterpart, a cylindrical plug frame 4 to which a rear portion of the locking housing 3 is fixedly connected and configured to support the front housing 2 so as to be slidable, a ferrule 16 held in the interior of the plug frame 4 and configured to be biased forward by a spring 17 which obtains a reaction force from the locking housing 3, a boot 23 configured to be mounted on the rear portion of the locking housing 3, and a swage ring 23a.

[0013] In the optical connector plug 1 with a shutter, as illustrated in Figs. 1A and 2A, projections 2b provided on upper side walls of the front housing 2 abut against edge portions of an opening of the LC type adapter 24 when being fitted to the LC type adapter 24, so that the front housing 2 having the projections 2b formed integrally on an outer peripheral portion is moved rearward.

[0014] Accordingly, as illustrated in Figs. 1B and 2B, the plug frame 4 which slidably supports the front housing 2 moves forward relatively with each other. Subsequently, an edge portion of the opening located on a front portion of the plug frame 4 causes the shutter 5, which is provided on an opening side of the front housing 2 and is curved on an optical axis so as to block light, to deploy into a straight shape. In this manner, a distal end portion of the ferrule 16 included in the plug frame 4 projects outward from the opening of the front housing 2.

[0015] When the optical connector plug 1 with a shutter is fitted into the LC type adapter 24 as illustrated in Figs. 1A, 1B, and 4, the front housing 2 retracts as illustrated in Figs. 2A and 2B, and hence the plug frame 4 moves relatively forward and an edge portion of an opening of the plug frame 4 abuts against and pushes the shutter 5, so that the shutter 5 is expanded from the curved shape to the straight shape.

[0016] At this time, in order to prevent the curved portion 5b of the shutter 5 from being deformed, the slits 5c configured to cancel a protrusion of a center portion of the shutter in an expanded state when being fitted due to deformation are formed so as to straddle a boundary portion between the flat portion 5a and the curved portion 5b in a state in which light is blocked by the shutter 5 as illustrated in Fig. 3A.

[0017] In addition, as a measure to ensure retention of the shutter 5, retention of the shutter 5 at the flat portion 5a is achieved by a retaining hole 5d provided at a center of the flat portion 5a to be engaged with a locking projection 2d of the front housing 2 and locking protrusions 5e and 5e formed at both left and right end portions of a rear end portion of the flat portion 5a to be locked by locking portions 2e and 2e of the front housing 2 as illustrated in Figs. 3A, 3B, 4A, and 4B.

[0018] When comparing with a shutter 22 of the prior art illustrated in Figs. 8A and 8B, the shutter 5 of this embodiment is retained with respect to the front housing 2 at three positions, namely by the retaining hole 5d and the locking protrusions 5e and 5e in contrast to a retaining mechanism of the prior art in which the shutter is retained only at one position at a retaining hole 22c (see Figs. 3A and 3B).

[0019] A front housing 19 of the prior art is provided with a locking projection 19c at one position, namely, at a center of a bottom portion as illustrated in Figs. 8A and 11B as the retaining mechanism of the shutter 22c. In

contrast, the front housing 2 of the optical connector plug 1 with a shutter of the invention is provided with the locking projection 2d at one position and the locking portions 2e at two positions as illustrated in Figs. 3A, 4A, and 4B. In this manner, the optical connector plug 1 with a shutter of the invention is configured to prevent the deformation of the shutter 5 when being fitted by the slits 5c and is provided with the locking protrusions 5e at two positions added thereto as the measure to ensure retention of the shutter against deformation. Therefore, deformation of the shutter when the optical connector plug 1 is fitted into the LC type adapter is restrained, and retention of the shutter is ensured.

Example 2

[0020] Fig. 5 illustrates the shutter 5 of the optical connector plug 1 with a shutter of Example 2 of the invention. The shutter 5 includes the slits 5c at three positions. Although the number and the size of the slits 5c are not specifically limited, deformation of the shutter may be prevented by adjusting the number and the size optimally as needed.

Industrial Applicability

[0021] The optical connector plug with a shutter of the invention is applied as a plug to be fitted to an optical connector adapter such as the LC type adapter, and may be widely applied to the plug or the like for optical communication having a curved one plate of shutter.

Claims

1. An optical connector plug with a shutter to be fitted to an optical connector adapter (24), comprising:

   a plug frame (4) configured to hold a ferrule (16);
   a square cylindrical front housing (2) arranged so as to be slidable on the plug frame (4) and including a shutter (5) configured to open and close in association with a movement of the ferrule (16) at a distal end side opening;
   a locking housing (3) fixedly and integrally connected to the plug frame (4) configured to be fitted into and be locked with the optical connector adapter (24); and
   a spring (6) configured to bias the front housing (2) forward, wherein
   the plug frame (4) relatively moves forward by a rearward movement of the front housing (2) so that a front opening edge portion of the plug frame (4) expands the shutter (5) which is curved on an optical axis of the distal end side opening of the front housing (2) and blocking light into a straight shape, and
   the shutter (5) includes a slit (5c) so as to straddle over a boundary portion between a flat portion (5a) and a curved portion (5b) in a state in which light is blocked, and a protrusion formed by a center portion being deformed in a state in which the shutter (5) is expanded when being fitted into the optical connector adapter (24) is cancelled.

2. The optical connector plug with a shutter according to Claim 1, wherein
   a retaining mechanism which retains the shutter (5) from coming off the front housing (2) includes a retaining hole (5d) formed at a center of the flat portion (5a) of the shutter (5), locking protrusions (5e) formed at both rear ends of the flat portion, a locking projection (2d) to be fitted to the retaining hole (5d) formed in the front housing (2), and locking portions configured to lock the locking protrusions (5e).

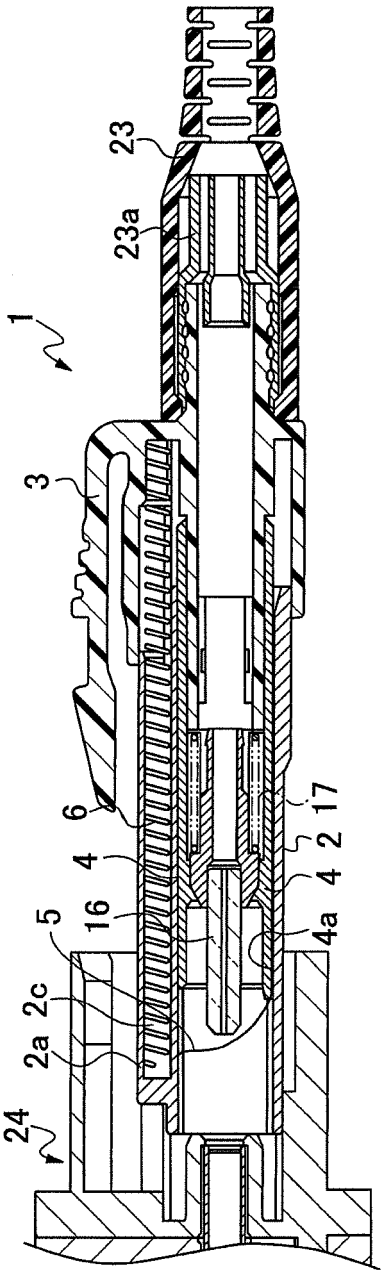

Fig. 1A

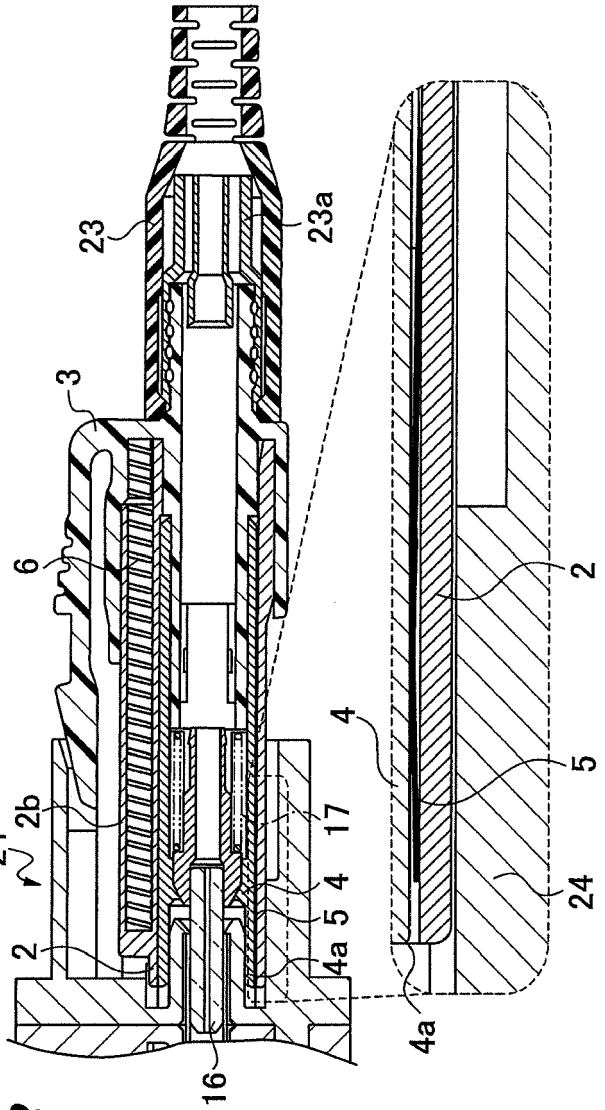

Fig. 1B

Fig. 2A

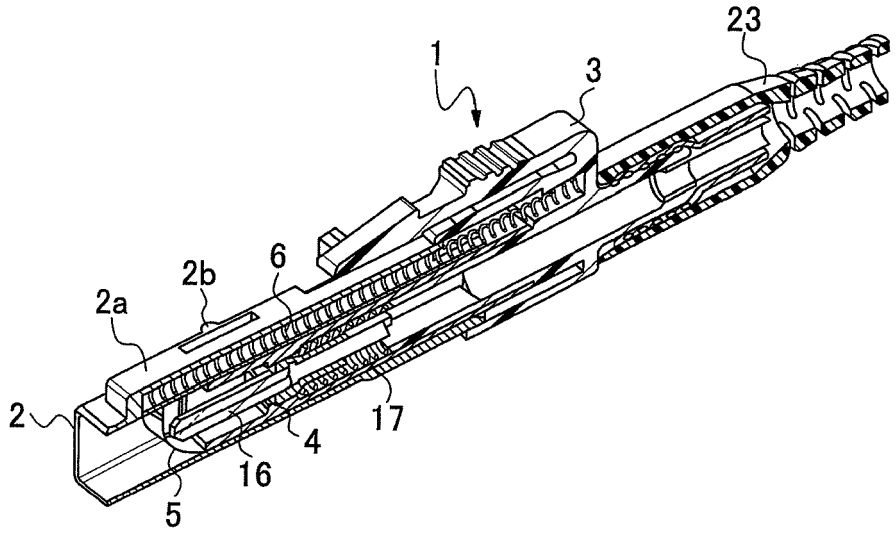

Fig. 2B

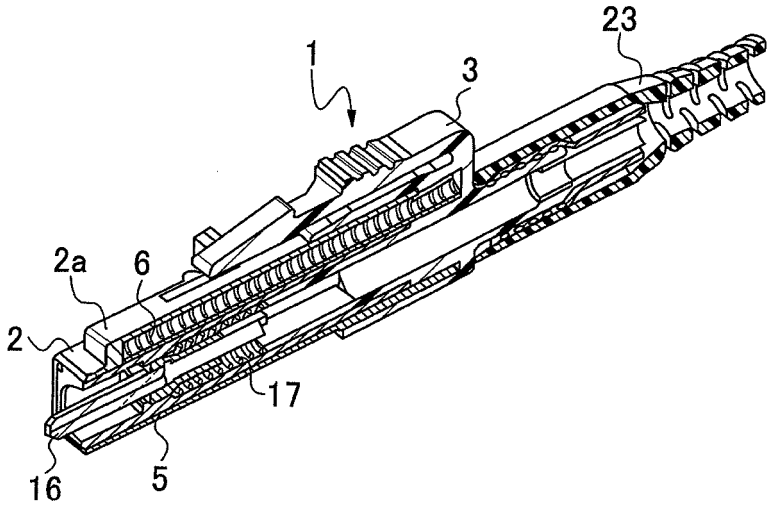

Fig. 3A

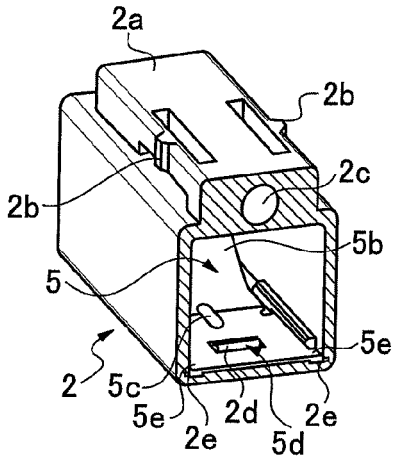

Fig. 3B

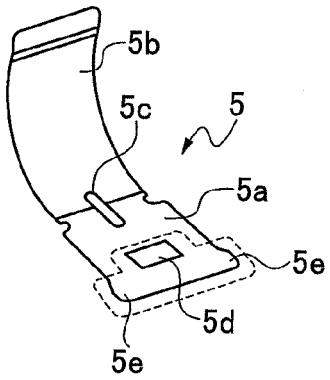

Fig. 4A

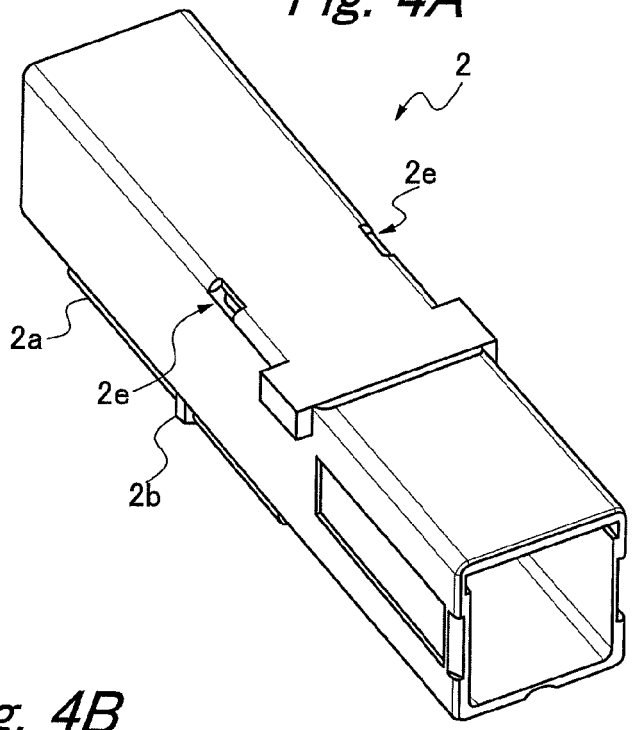

Fig. 4B

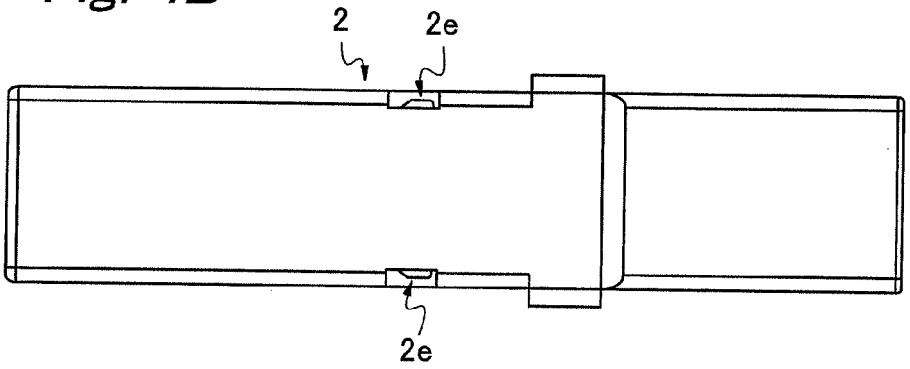

Fig. 5

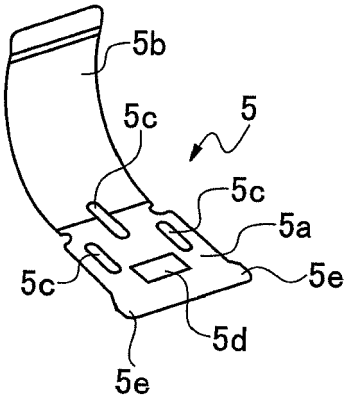

Fig. 6A

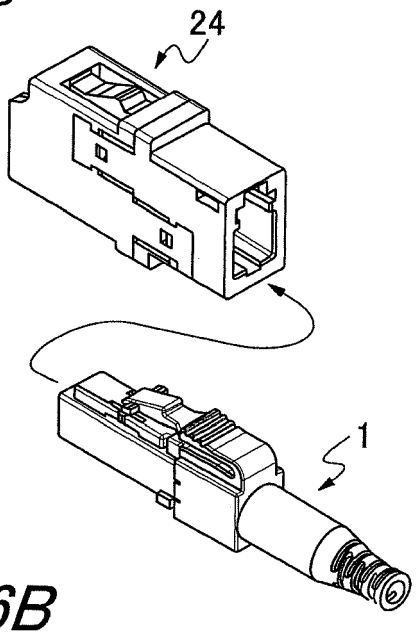

Fig. 6B

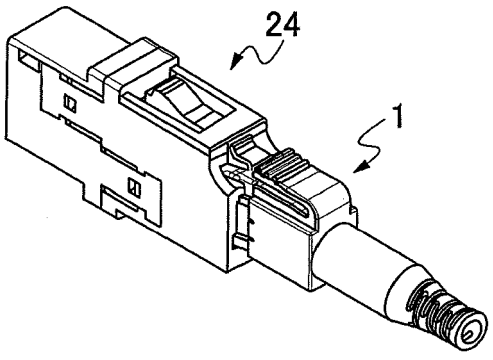

Fig. 7A
PRIOR ART

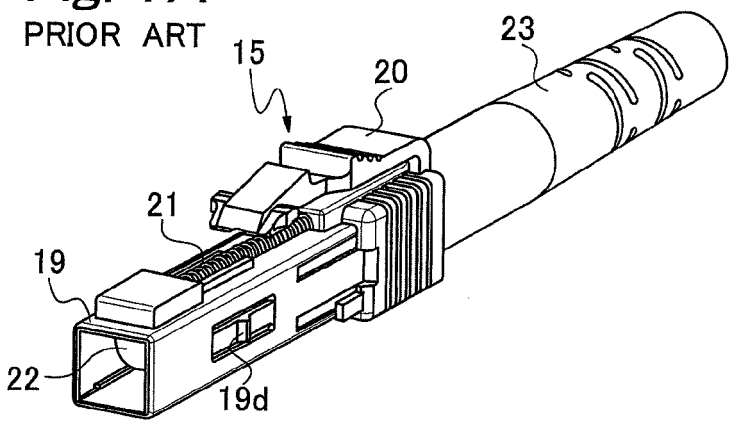

Fig. 7B
PRIOR ART

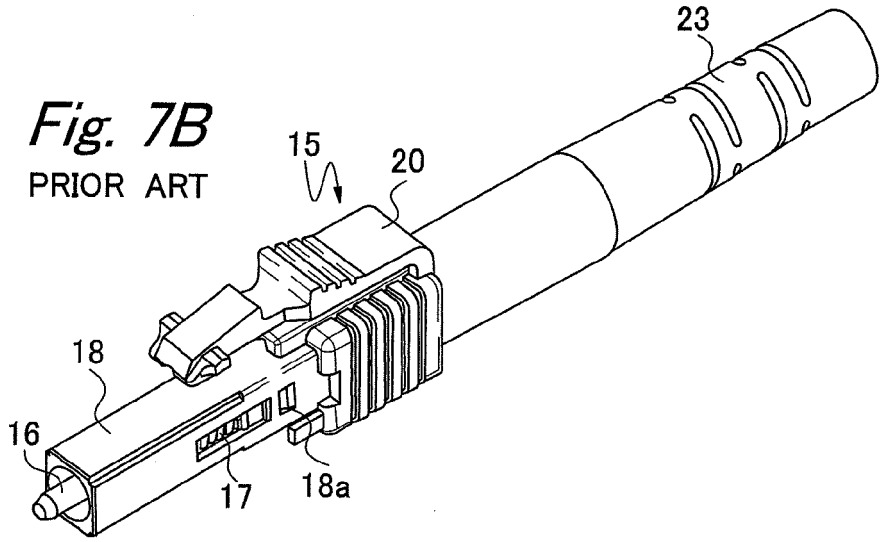

Fig. 8A
PRIOR ART

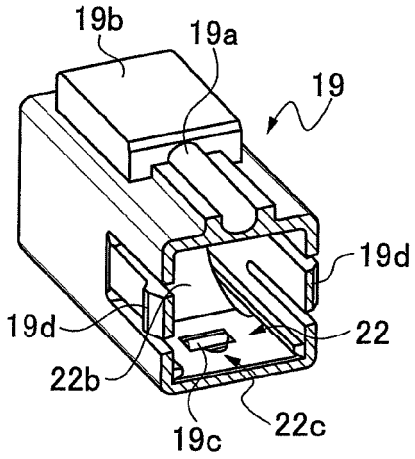

Fig. 8B
PRIOR ART

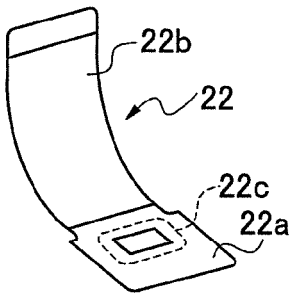

Fig. 9A
PRIOR ART

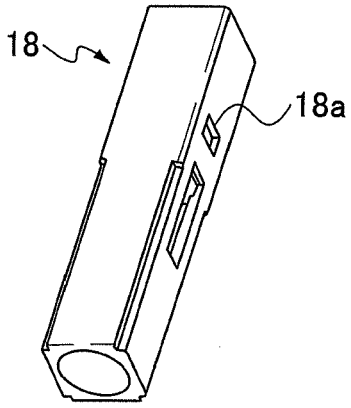

Fig. 9B
PRIOR ART

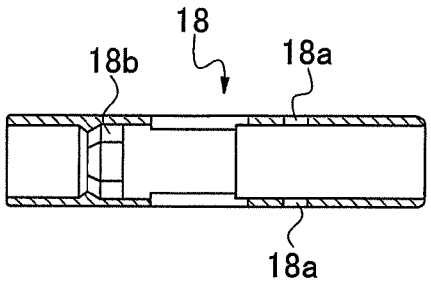

Fig. 9C
PRIOR ART

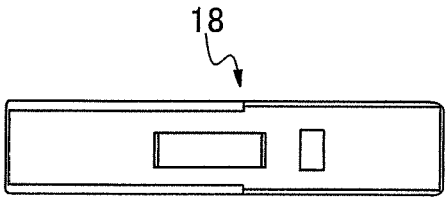

Fig. 9D
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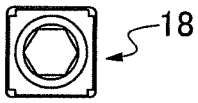


Fig. 9E
PRIOR ART

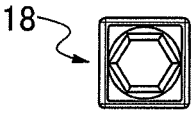


Fig. 10A
PRIOR ART

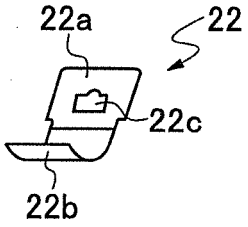


Fig. 10B
PRIOR ART

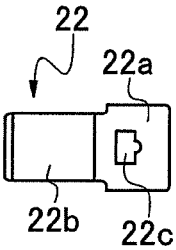


Fig. 11A
PRIOR ART

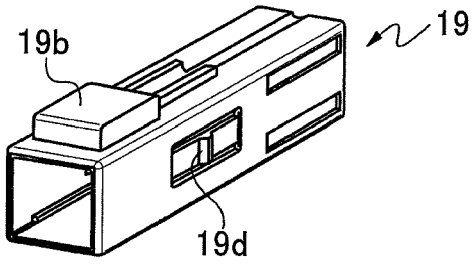


Fig. 11B
PRIOR ART

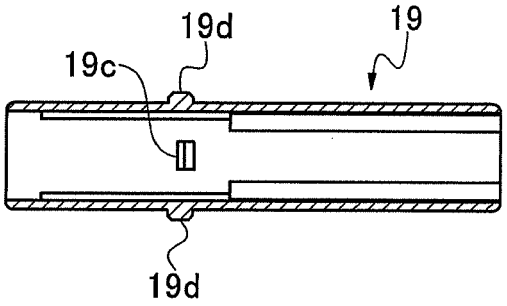
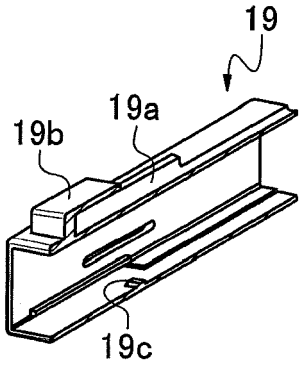


Fig. 11C
PRIOR ART



Europäisches Patentamt
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EUROPEAN SEARCH REPORT

Application Number
EP 14 17 7452

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y,D	JP 2011 013606 A (HONDA TSUSHIN KOGYO CO LTD) 20 January 2011 (2011-01-20) * figures 1, 4c,12 *	1,2	INV. G02B6/35 G02B6/38
Y	GB 1 058 886 A (PHILIPS NV) 15 February 1967 (1967-02-15) * figure 3 *	1,2	
Y	JP 2005 017598 A (SUNCALL CORP) 20 January 2005 (2005-01-20) * figure 8 *	1,2	

TECHNICAL FIELDS SEARCHED (IPC)

G02B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	17 December 2014	Jones, Julian

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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P : intermediate document

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 14 17 7452

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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17-12-2014

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